

The Real Story on Biofuel GHG Emissions

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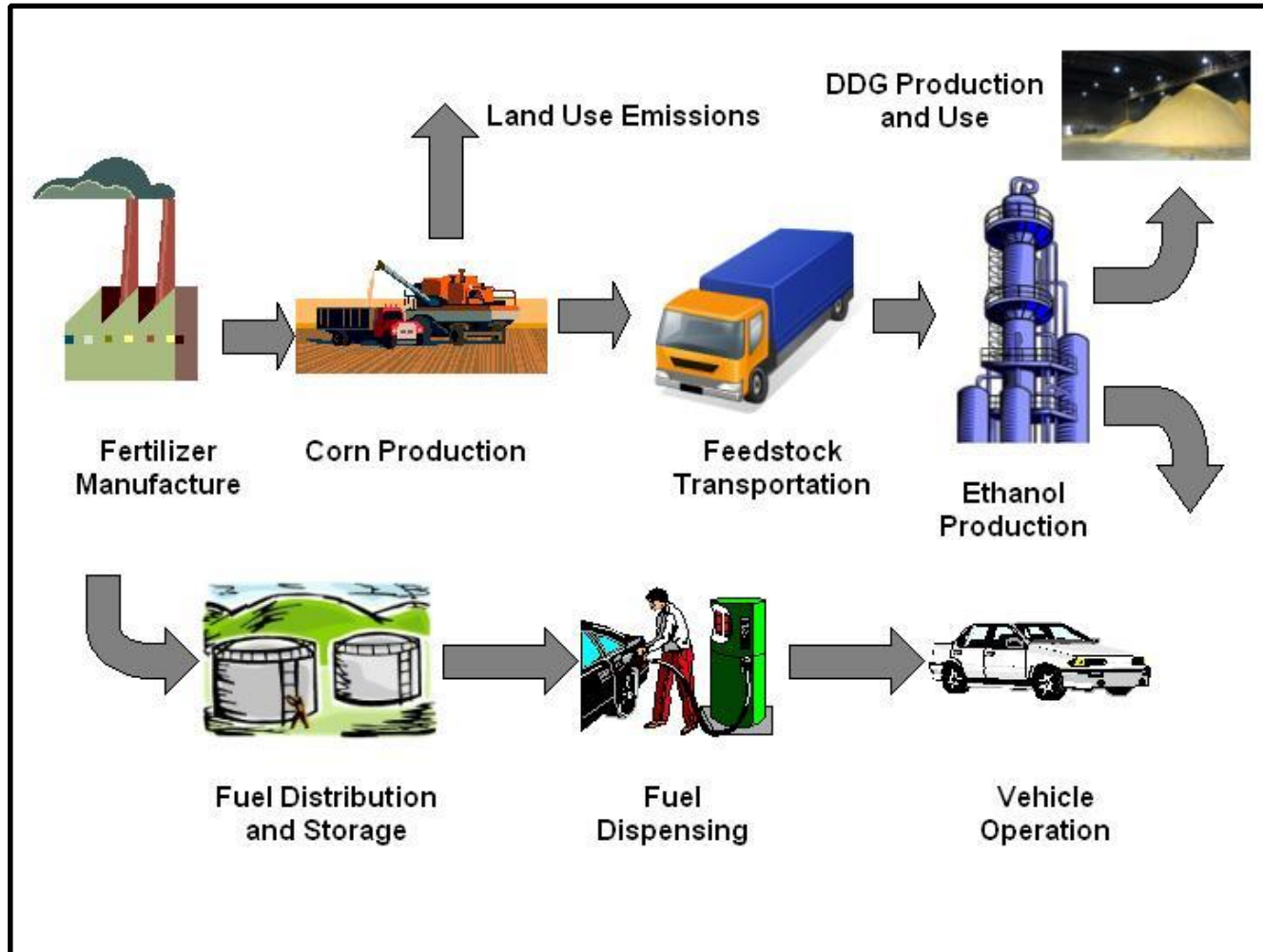
Complexity

- The GHG emissions of complex systems can be a challenge.
 - Data is not always as complete as one would like.
 - Data gaps are sometimes filled with passionate beliefs.
- Carbon Footprints are sometimes used instead of a proper comparative lifecycle analysis to reduce complexity. Carbon Footprints look at a single system in isolation.

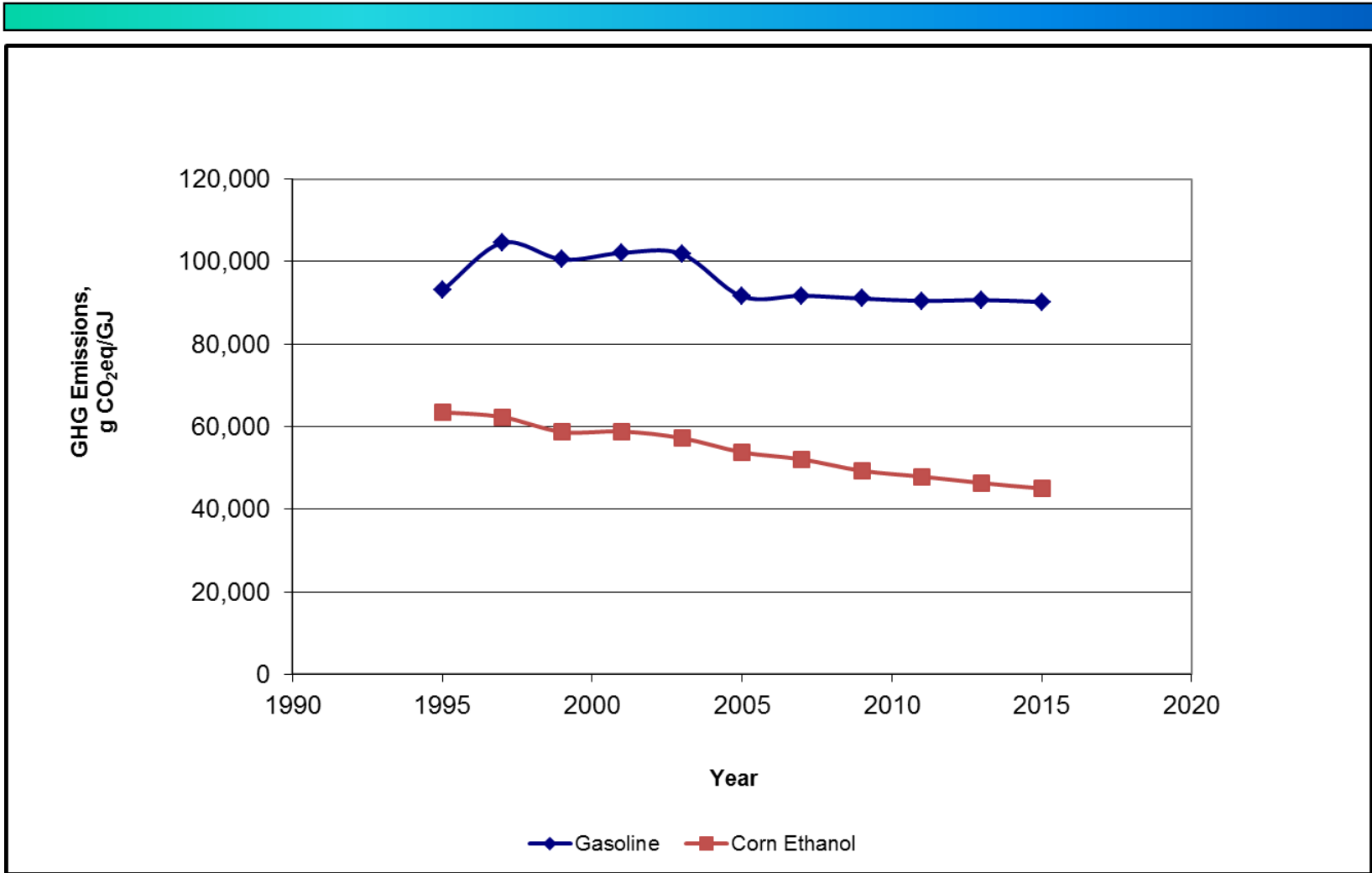
Carbon Footprints

- We mostly use Carbon Footprints to regulate fuels
 - US EPA, CARB, BC LCFS, Ontario Greener Diesel.
- Generally straightforward analysis
 - We look at the fuel production system.
 - Only a few data gaps.
 - Still use a lifecycle approach.

Carbon Footprints



Things Change Over Time



Lifecycle Analysis

- We look at equivalent systems **relative** to one another.
 - There are significant data gaps.
- Some people like to look at consequential lifecycle analyses, what happens if we do this compared to not doing it?
 - Greatly increases complexity
 - Requires an alternate universe to answer the questions definitively.

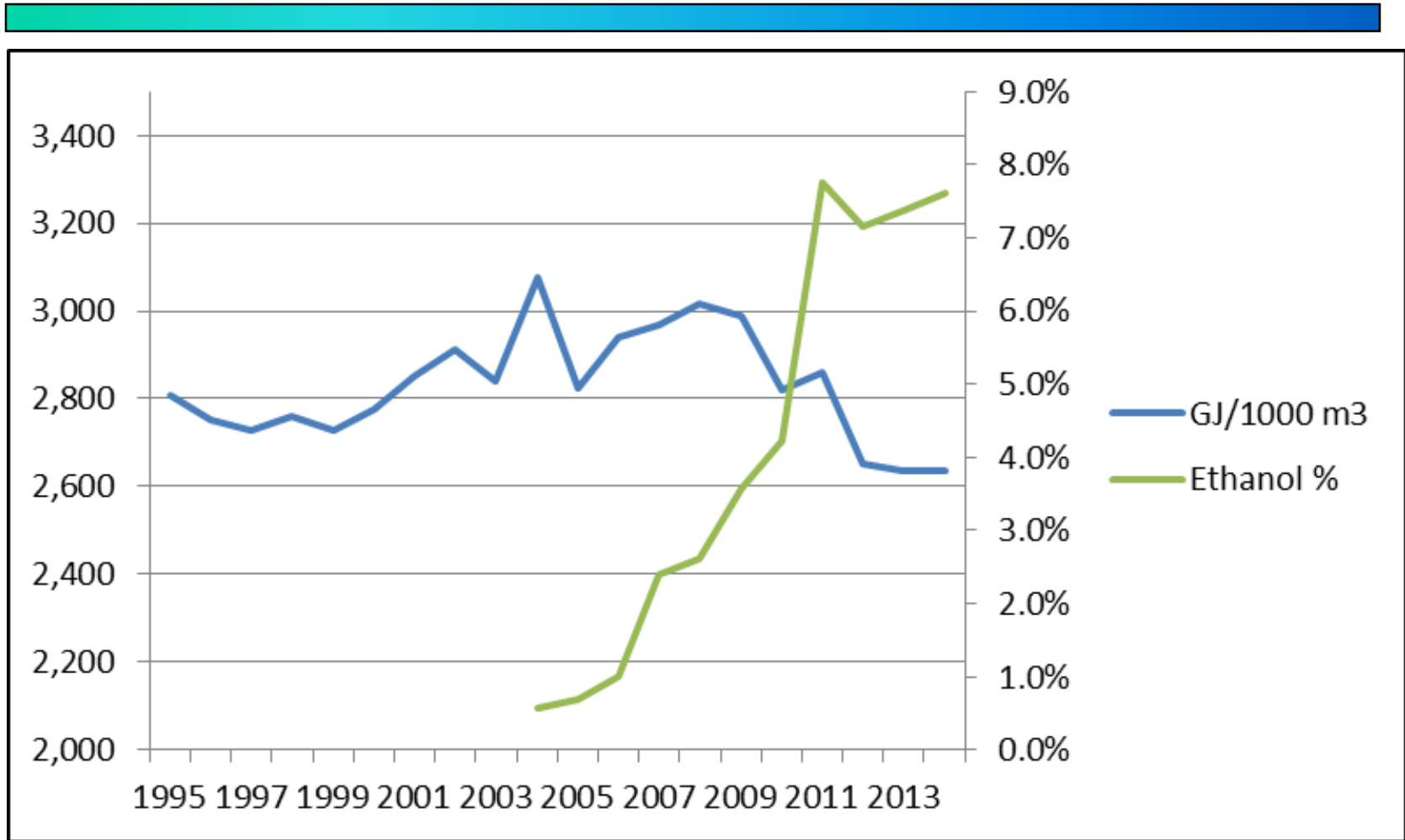
Lifecycle Analysis

- Ethanol is not the same as gasoline and biodiesel is not the same as petroleum diesel.
 - Combustion efficiency of ethanol is higher than gasoline. Relatively easy to adjust for in GHG modelling but not captured in regulatory systems.
 - Ethanol has an octane value of 113 vs gasoline at 87. Reduces energy use and emissions in the refinery. More difficult to account for because of a lack of refinery data.
 - How do we account for the emissions from burning the residual fuels that we get when we refine crude oil to produce transportation fuels?

Lifecycle Analysis

- Addressing each of these points improves the GHG emission performance of ethanol compared to gasoline.
- Ethanol offers a 50% reduction in gasoline on a pure energy content basis (Carbon Footprint).
 - Adjusting for engine efficiency increases this to 62%.
 - Including the emissions from the refinery bottoms adds another 5 percentage points to the reduction.
 - Various estimates for octane benefit but could increase the reduction to more than 100%.

Refinery Energy Use



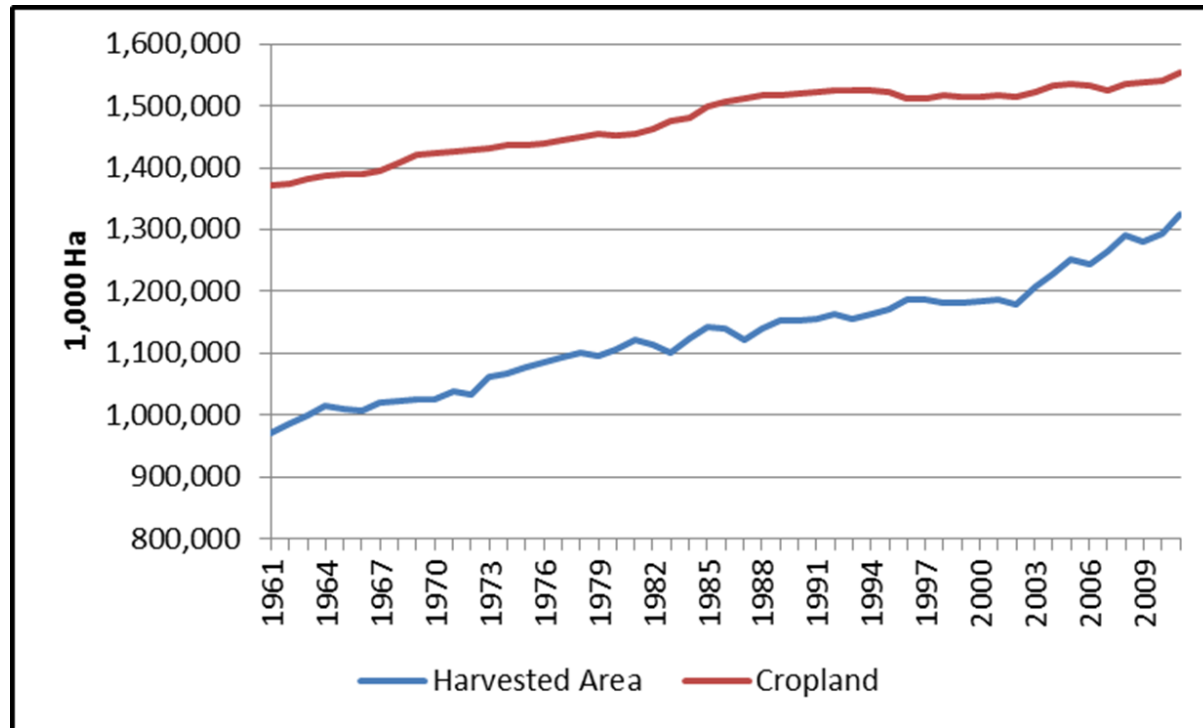
Source: Statistics Canada

Indirect Land Use Change

- Biofuel opponents like to suggest that expanding biofuel use will require converting natural grassland and forests to agriculture. Incurring carbon emissions from the stored carbon in the forests and the soils.
- Models have been developed to estimate what these emissions might be. The EPA and CARB include these emissions in their programs and biofuels are still less emission intensive than fossil fuels.
 - But the land use changes predicted by the models, more cropland, less forest and grassland haven't happened.
- Why?

Indirect Land Use Change

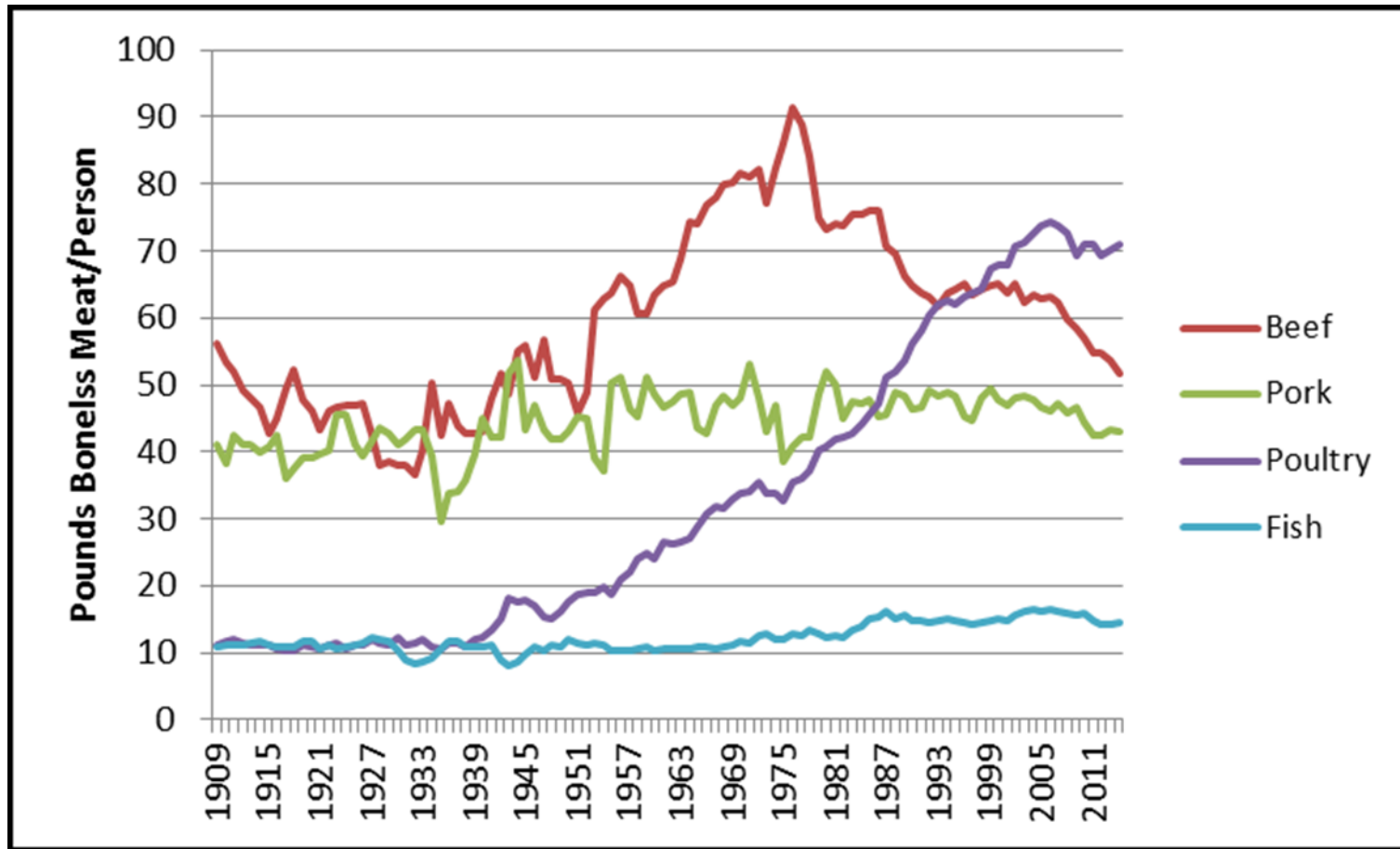
- Cropland is not fully utilized. 15 to 20% of the World's cropland is not being used in any given year.
- Utilization is getting better but there is still a lot of idle land.



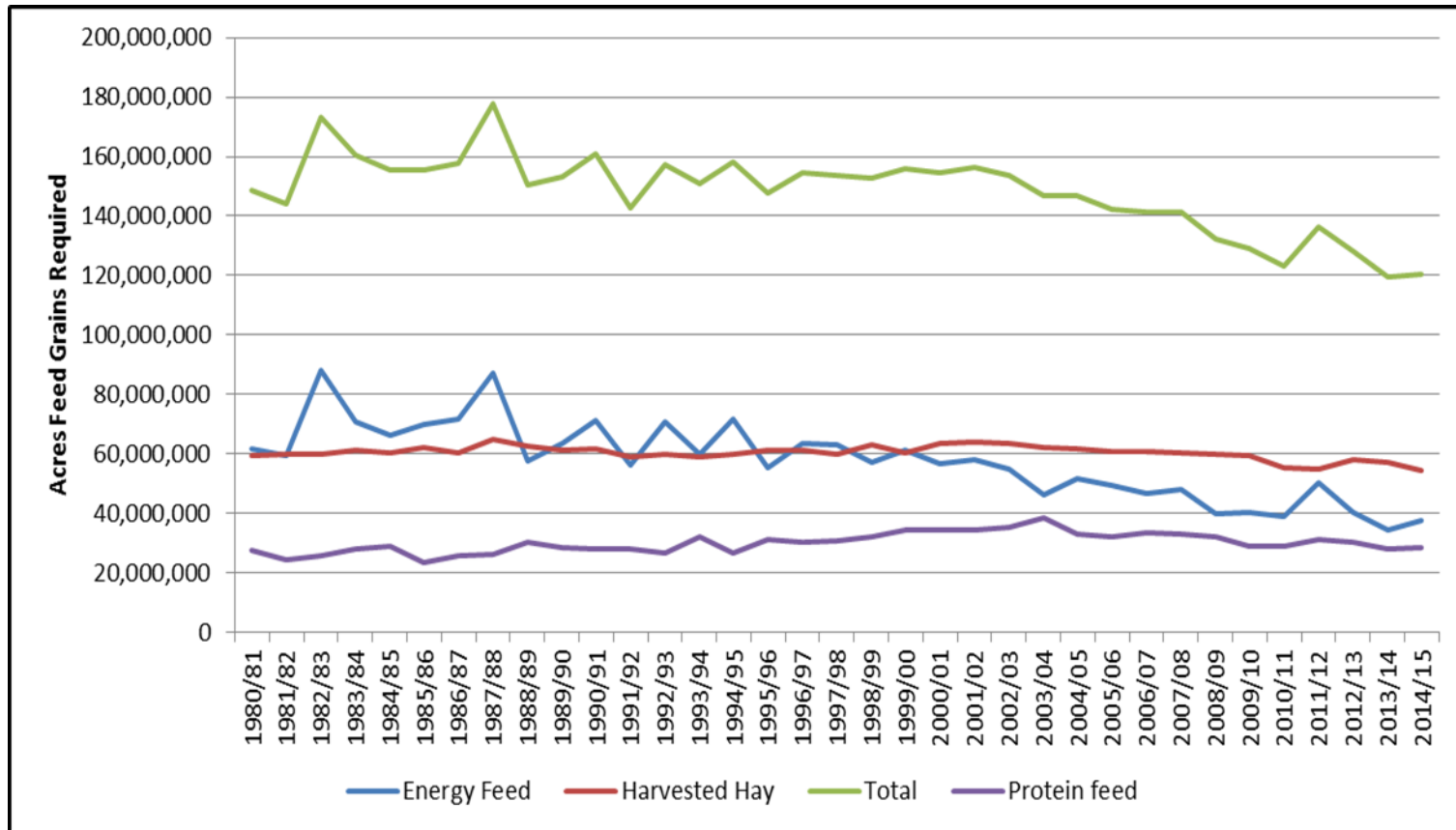
Indirect Land Use Change

- In the developed world, the demand for cropland for food and feed is actually dropping in spite of population growth.
 - Yield increases and shifting diets offset population growth.

US Meat Demand



US Livestock Land Demand



Summary

- Biofuels produce significant GHG emission reductions and they are getting better.
- The total system emission reductions are greater than most regulatory models and system estimate.
- Until someone develops an alternative universe time machine we will never know exactly what the benefits are.